CS 580-01 Spring 2025’s Course Progress Notes

**Major Topics Covered**

* Algorithms and Design (SDF)
	+ Concept and properties of algorithms, \_\_\_\_
	+ Role of algorithms,\_
	+ Problem-solving strategies,
	+ Separation of behavior and implementation
* Basis Analysis (AL)
	+ Asymptotic Analysis, empirical measurement.
	+ Differences among best, average, and worst case behaviors of an algorithm.
	+ Complexity classes, such as constant, logarithmic linear, quadratic, and exponential.
	+ Recurrence Relations and their solutions.
	+ Time and space trade-offs in algorithms.
* Algorithmic Strategies (AL)
	+ Brute-force, divide-and-conquer, transformation, greedy, dynamic programming, heuristics
* Fundamental Data Structures and Algorithms (AL)
	+ Binary search, Insertion sort, Selection sort, Shell sort, Quicksort, Mergesort, Heapsort.
	+ Binary heaps, Binary search trees, hashing.
	+ Representations of graphs and Trade-offs
	+ Fundamental graph algorithms including BFS and DFS, Shortest paths, and Minimum spanning trees.
	+ Substring search, Pattern matching.
* Basic Automata, Computability and Complexity (AL)
	+ Finite-state machines, Regular expressions
	+ Complexity classes P, NP, NP-completeness, NP-complete problems, reductions
* Advanced Data Structures, Algorithms and Analysis (AL)
	+ Balanced trees (e.g., Balanced search trees, AVL-trees, Red-Black Trees, B-trees)
	+ Graphs (Topological sort, Strongly connected components)
	+ Advanced data structures (disjoint sets, mergeable heaps) [optional]
	+ Network flows
	+ Linear programming
	+ Polynomials and the FFT
	+ Number-theoretic algorithms including Primality testing, RSA public-key cryptosystem
	+ Approximation algorithms including TSP
	+ Computational geometry including Convex hull, Geometric search and intersection
	+ Randomized algorithms such as, Rabin-Karp string matching, String sorts, Tries
	+ Data compression. [optional]
* Parallel algorithms, analysis and programming (PD) [optional]
* Formal Models and Semantics (PD) [optional]